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Low-FODMAP diet in the management of irritable bowel syndrome

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Abstract

Background: Fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAPs) are short-chain carbohydrates poorly absorbed by humans due to their small size, high osmotic activity, and the speed with which they are fermented by the microbiota. This causes abdominal pain, diarrhea and or constipation, and bloating. Studies about low-FODMAP diet to reduce the symptoms presented by patients with irritable bowel syndrome (IBS) have recently grown. This study aims to identify the characteristics and the risks of low-FODMAP diet to irritable bowel syndrome patients.

Methods: Electronic databases were used to search for the following words and/or expressions: "FODMAP Diet," "Low FODMAP diet," "irritable bowel syndrome," and "Diet in IBS." The study was carried out between February and September 2017.

Results: The low-FODMAP diet consists of two phases: in the first phase, carbohydrates associated with symptom induction in IBS patients and with the evaluation of the improvement conditions are eliminated or reduced; in the second phase, the eliminated groups are gradually reintroduced according to the presented symptomatology.

Conclusions: The low-FODMAP diet restrains the intake of certain food, and it leads to significant improvement in the symptoms of irritable bowel syndrome patients. However, some nutritional deficiencies may occur, if there is inadequate nutritional guidance, highlighting the need for adequate dietary management.

Keywords: FODMAPs, Low-FODMAP diet, Irritable bowel syndrome, Carbohydrates

Background

FODMAP is an acronym for fermentable oligosaccharides, disaccharides, monosaccharides, and polyols, which are known as short-chain carbohydrates poorly absorbed by humans. Such characteristic is related to their small size, high osmotic activity, and the speed with which they are fermented by the microbiota. This process produces gases and osmotically active byproducts [1–3]. This causes abdominal pain, diarrhea and or constipation, and bloating.

FODMAPs have low digestibility in the gastrointestinal tract and fermentation capacity in the bowel [4]. They have three possible common functional properties, as follows [5]:

- Low absorption in the small intestine—which is generated by lack of enzymes capable of hydrolyzing glycosidic bonds, lack or low activity of border enzymes in intestinal brush border, and low capacity of epithelial transporters, and is related to the polyols, due to their large size for simple diffusion [1, 5–7];
- FODMAPs small size and high osmotic activity fosters water mobilization in the intestine, thus increasing the amount of fluids. It alters the intestinal function, causing abdominal distension and the exacerbation of symptoms [1, 5–7];
- Quick fermentation by bacteria—FODMAPs are substrates for gut bacteria in both healthy flora and dysbiosis. They increase gas production, which results in distension, pain, and swelling [1, 5–7].

The induction of symptoms related to FODMAPs in irritable bowel syndrome (IBS) patients remains unclear.

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However, it may occur due to the interaction of certain factors, such as [8]:

- Increased amount of water in the small intestine;
- Increased gas production;
- Increased intestinal motility which, in addition to the retention of gases, would lead to a change in the bowel movement. It affects defecation;
- Shift in the number and composition of these patients' gut microbiota.

FODMAPs are fermented by the local microbiota in the large intestine, and it increases the amount of hydrogen gas, carbon dioxide, methane, and short-chain fatty acids in the lumen. Such process results in abdominal distension, bloating, flatulence, and pain [4, 9].

FODMAPs and the irritable bowel syndrome

Irritable bowel syndrome (IBS) is a functional disorder of the intestine, defined from diagnoses primarily based on the presence of symptoms and on lack of organic causes. It is usually characterized by changes in the bowel habit in association with abdominal pain and/or abdominal discomfort, distension, bloating, and flatulence [10].

Treatment of IBS consists of pharmacological and non-pharmacological measures. Among the non-pharmacological measures, it is possibly highlighting the actions taken to reduce stress (a factor strongly associated with crises) and food adequacy through the restriction of certain food (i.e., FODMAPs) associated with the onset of symptoms [10–13]. The distension caused by unabsorbed and/or fermented FODMAPs can be the basis for the most common symptoms in IBS [1, 14]. Table 1 [15] presents the main sources and maximum intake dose of FODMAPs not associated with the onset of symptoms in individuals with IBS.

Regarding the relevance of dietary treatment in IBS, the aim of the present review was to identify the characteristics and the risks of the low-FODMAP diet.

Table 1 FODMAP types, sources, and maximum intake doses

FODMAP	Main sources	Maximum dose (portion)
Fructans	Onion, garlic, artichoke and wheat	0.2 g
Galactans	Grain legumes (bean, lentil, chickpea)	0.3 g
Lactose	Milk and milk products	< 1.0 g
Fructose	Apple, peach, honey, corn syrup	< 0.15 g[a]
Polyols	Blackberry, apricot, apple, sorbitol, xylitol, mannitol	< 0.4 g

[a]Fructose in excess of glucose

Methods

PUBMED electronic database was used to search for the following words and/or expressions: "FODMAP Diet," "Low FODMAP diet," "Irritable Bowel Syndrome," and "Diet in IBS," between February and September 2017.

Articles related to bowel inflammatory disease were excluded, as well as articles related to celiac disease and food allergy. Only studies performed in humans were included. The search resulted in 90 articles.

Results

The low-FODMAP diet

The benefits of restricting FODMAP-rich food for individuals with IBS have been reported by several authors. Shepherd et al. (2008) noticed the improvement of symptoms related to diet restrictions in 74% of IBS patients; treatment efficacy was directly associated with the patient's commitment to the diet [16]. Whelan et al. [17] remarked that the low-FODMAP diet, delivered through dietitian-led dietary counseling, is effective in the management of functional gastrointestinal symptoms in IBS.

FODMAP-rich food is eliminated or restricted in the low-FODMAP diet in order to detect the groups exacerbating the symptoms in each individual. As a result, the diet encompasses two phases; the first one is the withdrawal of these carbohydrates from the diet, which should contain less than 0.5 g per meal or less than 3 g per day [7, 18, 19].

Based on the current literature, it is not possible to assume that only a specific food group causes symptoms related with FODMAPs. Also, it is possible that individual characteristics (i.e., genetics and intestinal function) related to the ingestion of FODMAPs imply in a threshold to each food type.

Phase 1 of the diet lasts 4 to 8 weeks, on average, during which the FODMAP-rich food undergo full exclusion. Table 2 presents the food to be avoided and consumed in the first phase [3, 5, 7, 20].

At the beginning of diet implementation, the dietitian should conduct a detailed questionnaire on the symptoms presented, including type, frequency, and pattern, and whether there is a perception that some food causes discomfort, as well as it should be asked about associated psychological factors. Also, the dietitian should investigate the frequency of food intake, especially those "rich in FODMAPs" [4, 19].

The dietitian should explain to the patient, qualitatively and quantitatively, how the diet will be implemented, taking into account their lifestyle and eating habits, advise on foods with high and low content of FODMAPs. An important point is to emphasize that each person is unique and responds in a way to approach, that is, each one will have a level of tolerance to each type of food, emphasizing the importance of having

Table 2 High and low FODMAP foods

FODMAP	Examples of high-FODMAP foods	Examples of low-FODMAP foods
Oligosaccharides (fructans and galactans)	Vegetables: artichoke, asparagus, beet, broccoli, Brussels sprouts, cabbage, cauliflower, garlic, leek, okra, onion Cereals: wheat, barley and rye and their derivatives (bread, noodles, cookies) Legumes: bean, chickpea, lentil, red bean, pea, soybean Fruits: persimmon, custard apple, watermelon, peach Chestnuts: walnut, hazelnut, pistachio	Vegetables: carrot, lettuce, zucchini, pumpkin, bamboo shoots, pepper, celery, scallion, chard, tomato Cereals: rice, corn, tapioca, quinoa, oat and its derivatives An option to replace garlic and onion: garlic infusion in olive oil
Lactose	Cow, goat and sheep milk, fluid or powdered, condensed milk Ice cream Yogurt Cheeses: soft and fresh cheeses (for instance, cottage, ricotta and mascarpone)	Milk: low-lactose milk Ice cream replacers: sorbets Yogurts: low-lactose yogurts Cheeses: ripened cheese, brie, camembert, cheddar, feta, parmesan
Fructose	Fruits: apple, peach, mango, pear, watermelon, fruit syrup Honey sweeteners: fructose, high fructose corn syrup Vegetables: asparagus, artichoke Sweet wines Large total fructose dose: concentrated fruit sources, large servings of fruit, dried fruit, fruit juice	Fruits: banana, blueberry, melon, star fruit, grape, melon, kiwi, lemon, orange, passion fruit, papaya, raspberry, strawberry, tangerine Sweeteners: any sweetener, except for polyols
Polyols	Fruits: apple, apricot, avocado, cherry, lychee, nectarine, peach, pear, plum, prune, watermelon Vegetables: cauliflower, mushroom Sweeteners: isomalt, maltitol, mannitol, sorbitol, xylitol and other sweeteners ending with "-ol"	Fruits: banana, blueberry, melon, star fruit, grape, kiwi, lemon, lime, orange, passion fruit, papaya, raspberry Sweeteners: glucose, sugar (sucrose), other artificial sweeteners not ending with "-ol"

control and monitoring the symptoms and having a food diary [7].

The knowledge of the composition of industrialized foods is relevant to avoid the ingestion of large quantities of *high FODMAP* foods. In this sense, the reading of labels should be part of the routine of individuals who follow the diet with low content of FODMAP.

Also, it should be emphasized that the provision of adequate food alternatives considering the nutritional value of the food and the acceptance of the patient is fundamental to avoid possible nutritional deficiencies [5, 7].

The food of each subgroup should be progressively and exclusively reintroduced in phase 2 of the diet: at first, certain food with significant quantities of only one FODMAP should be selected, such as milk, which contains a large proportion of lactose, but has no other subgroup. This fragmentation happens due to the different effects FODMAPs cause in the gastrointestinal tract. Regarding the quantities, it is recommended to start reinsertion with reduced portions for approximately 3 days, thereby checking the patient's acceptance to a particular category [7, 21].

In case of significant worsening of the symptoms or of their intensity, it is recommended to interrupt the approach of a particular group. If there is no worsening, the individual is encouraged to increase the intake dose of the group in question in order to reach the usual consumption portion. Subsequently, the process for the next subgroup is initiated; 2 to 3 days of washout shall be performed between procedures to assure no cross-effects between categories. Given the reestablishment of tolerance to each group, the patient should be encouraged to increase the doses, the frequency and the combination of high-FODMAP food. In this context, it is possible to improve the diet from the nutritional point of view [21].

Potential limitations and risks of low-FODMAP diet implementation

Alteration in the gut microbiota composition and the reduction of beneficial bacteria are likely to occur when fructans and galactans are eliminated [8, 15, 18]. Consequently, there is short-term risk associated with insufficient carbohydrate, dietary fiber, B group vitamins, and calcium intake. In addition, if the restricted diet goes on, these inadequacies may extend for longer periods. It is also possible that patients face weight loss due to the dietary restriction [7, 8, 22, 23].

Lack of clear tolerance values to groups covered by the FODMAP's acronym, and also to values of these subgroups in food and the numbers reporting individual and population consumption are other points of extreme relevance. Currently, there are food composition databases with limited descriptions of these carbohydrates contents [5, 6, 8, 23, 24].

The existence of tolerance values of the FODMPAS intake would allow improvement of nutritional guidance. However, the scarcity of data regarding the values of such oligosaccharides in foods compromises the indication of their use, which contributes to limit the food intake of this group of FODMAP. Also, it should be mentioned that not all food analysis laboratories are capable of identifying FODMAP content in food.

It should be pointed out that there is a need for a global standardization of the methods used to analyze the content of FODMAPS in food so that several laboratories around the world can analyze the products in the same way. This topic gains more pertinence with the lack of composition tables and local lists for each region that bring this information [5, 6, 8, 23, 24]. In this way, the existence of more reliable regional data will contribute to a more effective treatment as it will bring more qualitative and quantitative information. Also, different eating habits around the world should be considered in the prescription of a diet with low content of FODMAP, thus emphasizing the need to individualize the diet, respecting habits and their own culinary practices.

Conclusion

The low-FODMAP diet restricts the intake of some food, such as certain fruits, dairy products, grain legumes, and wheat. Adherence to this diet provides remarkable improvement of symptoms in irritable bowel syndrome patients, besides reducing bloating, abdominal pain, and diarrhea. Nevertheless, it is advisable to follow suitable meal plans conducted by skilled dietitians to avoid possible nutritional deficiencies as the consequence of adopting a low-FODMAP diet.

Abbreviations

FODMAP: Fermentable oligosaccharides, disaccharides, monosaccharides, and polyols; IBS: Irritable bowel syndrome

Authors' contributions

The authors contributed equally to this work. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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